Radiological Safety Analysis Document

This Radiological Safety Analysis Document (RSAD) identifies the radiation budget for the experiment, the verification process for the radiation budget, and controls with regard to production, movement, or import of radioactive materials.

I. Description

This document covers the radiological safety aspects of pre-run commissioning of beamline, diagnostics, dump and detector systems in Hall A for the E08-027 (g2p) and E08-007 experiments using low-current beam for the period from approximately December 12 to December 22, 2011. The experimental target, local dump and target chicane magnet systems will not be commissioned. No polarized target will be installed. A length of PVC tubing will replace the polarized target system. Beam will go only to the straight-ahead high-power dump in Hall A.

A full description of the test setup, beam parameters and restrictions can be found in TOSP No. PHY-11-034-TOSP. Operations beyond the scope of that TOSP must be approved by the RadCon department head. Part of the commissioning will involve use of a thin ^{12}C foil (0.010"). Nominal beam conditions will be 1.7 GeV and ~1 μA. Commissioning of the dump viewer may require several μA or more in order to see the beam spot (up to 10 μA for this purpose is approved under this RSAD).

II. Summary and Conclusions

The commissioning run is not expected to contribute any significant dose at the Jefferson Lab boundary given the low beam power, lack of target, and duration of run. No manual manipulations of the carbon foil target are to be made without RadCon approval. Site boundary doses will be monitored by RadCon to ensure that the site boundary goal is not exceeded. The experiment may cause Radiation Areas in the Hall. High Radiation Areas are not expected, but could occur in the event of poor beam quality or beam loss issues. **Adherence to this RSAD is vital.**

III. Calculations of Radiation Dose at Site Boundary

The radiation budget for a given experiment is the amount of radiation that is expected at site boundary as a result of a given set of experimental conditions. This budget may be specified in terms of mrem at site boundary or as a percentage of the Jefferson Lab design goal for dose to the public, which is 10 mrem per year. The Jefferson Lab design goal is 10% of the DOE annual dose limit to the public, and cannot be exceeded without prior written consent from the Radiation Control Department Head and the Director of Jefferson Lab. Site boundary doses were not formally calculated for this commissioning run. Historical data and scaling to present conditions suggests boundary radiation levels will be negligible. This expectation will be verified during the run by use of the installed active boundary monitors. Any unusual radiation levels will be investigated immediately by RadCon and appropriate actions taken to mitigate the conditions.

IV. Radiation Hazards

The following controls shall be used to prevent the unnecessary exposure of personnel and to comply with Federal, State, and local regulations, as well as with Jefferson Lab and the Experimenter's home institution policies.

A. From Beam in the Hall

When the Hall status is Beam Permit, there are potentially lethal conditions present. Therefore, prior to going to Beam Permit, several actions will occur. Announcements will be made over the intercom system notifying personnel of a change in status from Restricted Access (free access to the Hall is allowed, with appropriate dosimetry and training) to Sweep Mode. All magnetic locks on exit doors will be activated. Persons trained to sweep the area will enter by keyed access (Controlled Access) and search in all areas of the Hall to check for personnel.

After the sweep, another announcement will be made, indicating a change to Power Permit, followed by Beam Permit. The Run-Safe boxes will indicate "OPERATIONAL" and "UNSAFE". IF YOU ARE IN THE HALL AT ANY TIME THAT THE RUN-SAFE BOXES INDICATE "UNSAFE", IMMEDIATELY PRESS THE "PUSH TO SAFE" BUTTON ON THE BOX.

Controlled Area Radiation Monitors (CARMs) are located in strategic areas around the Hall and the Counting House to ensure that unsafe conditions do not occur in occupiable areas. This experiment may create regions of increased radiation outside the hall in areas not normally controlled for radiological purposes. The RadCon Department will monitor the CARMs and make surveys as necessary to assess the impact of the experiment on radiation levels around the hall.

B. From Activation of Target and Beamline Components and Other Materials in the Hall

1. **The Radiation Control Department shall be consulted for all movement of used targets, collimators, and shields.** The Radiation Control Department will assess the radiation exposure conditions and will implement controls as necessary based on the radiological hazards.

2. **There shall be no local manipulation of activated target configurations without direct supervision by the Radiation Control Department.** Remote movement of target configurations is permitted using appropriately reviewed and approved methods.

3. **No work is to be performed on beamline components, which could result in dispersal of radioactive material** (e.g., drilling, cutting, welding, etc.). Such activities must be conducted only with specific permission and control by the Radiation Control Department.

4. **The PVC beamline insert and associated downstream beamline are expected to become activated.** There is some potential for local surface contamination on this section of the beamline. **No work on this portion of the beamline is to be conducted without RCD review.**

5. **A radiation area may develop near the target/beamline area.** Less likely, but possible high radiation areas could occur in this area and near the beam dump tunnel entrance. If these conditions occur, work in these areas will be governed by specific RWPs.

NOTE:

Work planning for all radiological work shall be coordinated through the hall work coordinator (E. Folts) using the ATLis work planning tool.

6. This experiment is not expected to produce levels of airborne radioactivity high enough to significantly impact environmental effluent standards. However, airborne radioactivity concentration in the hall is measured continuously. **If airborne radioactivity concentration as monitored by the AMS-4 air monitor in the experimental hall exceeds an average of 1.0E-6 μCi/cc for a period of greater than 5 consecutive days,** the Radiation Control Department (RCD) will investigate to

determine if the experimental conditions are accurate, and to assess what actions may reduce the airborne radioactivity levels to ensure that Jefferson Lab dose to the public from release of airborne radioactivity limits are not exceeded.

C. Other Sources

1. **All radioactive materials brought to Jefferson Lab shall be identified to the Radiation Control Department.** These materials include, but are not limited to radioactive check sources (of any activity, exempt or nonexempt), previously used targets or radioactive beamline components, previously used shielding or collimators, or He-3 containers. The RCD inventories and tracks all radioactive materials onsite. The Radiation Control Department may survey the experimental setup before experiments begin as a baseline for future measurements if significant residual activity levels are present.

2. **Tanks or cylinders of He-3 containing more than 10 mCi of tritium (H-3) shall not be stored or used in an experimental hall without the express, written permission of the RadCon manager. Any containers of He-3 brought on site shall be assessed for the tritium content before use.** Additionally, He-3 containers should not be stored in the experimental hall when not in use.

V. Incremental Shielding or Other Measures to be Taken to Reduce Radiation Hazards

No additional shielding is planned for this experiment. It is up to Physics Division management to consider the potential dose from this experiment and its impact on the annual dose budget.

The RCD Head will notify the Hall Leader and Physics Division Safety Officer of any identified trends which might impact access to the hall or create conditions requiring broad changes to radiological working standards (i.e. General Access RWP revision). The RCD head will recommend engineered or other controls considered necessary to prevent significant degradation of the radiological conditions in the hall.

VI. Operations Procedures

1. **All experimenters must comply with experiment-specific administrative controls.** These controls begin with the measures outlined in the experiment's Conduct of Operations Document, and also include, but are not limited to, Radiation Work Permits, Temporary Operational Safety Procedures, and Operational Safety Procedures, or any verbal instructions from the Radiation Control Department. A general access RWP governing access to the Halls and the accelerator enclosure must be read and followed by all participants in the experiment. This RWP can be read and electronically signed online at: http://www.jlab.org/accel/RadCon/pdf_forms/Gen%20Acc%20RWP.pdf

2. Any individual with a need to handle radioactive material at Jefferson Lab shall first complete Radiation Worker (RW-I) training.

3. **There shall be adequate communication between the experimenter(s) and the Accelerator Crew Chief and/or Program Deputy** to ensure that all power restrictions on the target are well known. Exceeding these power restrictions may lead to excessive and unnecessary contamination, activation, and personnel exposure.

4. **No beamline component may be altered** outside the scope of this RSAD without formal Radiation Control Department review. Alteration of these components (including the exit beamline itself) may result in increased radiation production from the Hall and a resultant increase in site boundary dose.

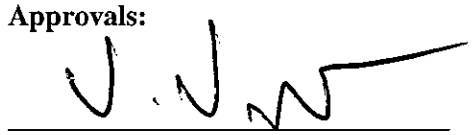
5. **Any requested changes outside of the experimental parameters submitted for radiation safety assessment (i.e., current, energy, target material, target thickness, run time)** for this experiment shall require a formal review by the Radiation Control Department, and a new revision to the RSAD.

VII. Decommissioning and Decontamination of Radioactive Components

Experimenters shall retain all targets and experimental equipment brought to Jefferson Lab for temporary use during the experiment. After sufficient decay of the radioactive target configurations, they shall be delivered to the experimenter's home institution for final disposition. All transportation shall be done in accordance with United States Department of Transportation Regulations (Title 49, Code of Federal Regulations) or International Civil Aviation Organization (ICAO) regulations. In the event that the experimenter's home institution cannot accept the radioactive material due to licensing requirements, the experimenter shall arrange for appropriate funds transfers for disposal of the material. Jefferson Lab cannot store indefinitely any radioactive targets or experimental equipment.

The Radiation Control Department may be reached at any time through the Accelerator Crew Chief (269-7045) or directly by calling the RadCon Cell Phone (876-1743). On Weekends, Swing Shift, and Owl Shift, requests for RadCon support should be made through the Crew Chief. This will ensure that there is prompt response with no duplication of effort.

Approvals:



Radiation Control Department Head

12/2/2011

Date